

AMENDMENTS TO THE CLAIMS

Claims 1-14. (Canceled)

15. (New) A substrate transportation apparatus for transporting substrates by feeding the substrates to a mounting unit which is to mount components onto the substrates and offer the substrates as component-mounted substrates, and by discharging the component-mounted substrates from the mounting unit, comprising:

a loader unit for loading a substrate along a substrate-transportation direction such that the substrate becomes positioned at a first substrate position, from among the first substrate position, a second substrate position, a third substrate position and a fourth substrate position, with the first, second, third and fourth substrate positions being arranged sequentially next to one another;

an unloader unit for unloading from the fourth substrate position a substrate positioned thereat;

a substrate feed holder for releasably holding the substrate positioned at the first substrate position and then transferring this substrate to the second substrate position;

a substrate discharge holder for releasably holding a substrate positioned at the third substrate position and then transferring this substrate to the fourth substrate position;

a holder moving unit for moving said substrate feed holder and said substrate discharge holder separately in a vertical direction and in an integrated state along the substrate-transportation direction; and

a substrate holding-and-moving device for releasably holding a substrate, said substrate holding-and-moving device capable of moving, while holding the substrate, to a substrate mounting region of the mounting unit, for mounting of a component onto the substrate, and also to the third substrate position, and said substrate holding-and-moving device also capable of moving to the second substrate position.

16. (new) The substrate transportation apparatus according to claim 15, further comprising:

a control unit for controlling respective holding operations of said substrate feed holder and said substrate discharge holder, a movement operation of said holder moving unit, and a movement operation of said substrate holding-and-moving device, such that

(i) said substrate discharge holder holds a component-mounted substrate on said substrate holding-and-moving device when positioned at the third substrate position, and then removes said component-mounted substrate from said substrate holding-and-moving device,

(ii) said substrate holding-and-moving device moves to the second substrate position,

(iii) said substrate feed holder supplies a substrate to said substrate holding-and-moving device when positioned at the second substrate position,

(iv) said substrate holding-and-moving device moves from the second substrate position, along with the substrate supplied by said substrate feed holder, to the substrate mounting region, and

(v) said substrate discharge holder moves, along with the component-mounted substrate held thereby, to the fourth substrate position.

17. (new) The substrate transportation apparatus according to claim 15, wherein said substrate holding-and-moving device is operable to move, along with a substrate held thereby, in a direction along the substrate-transportation direction which is along a surface of the substrate, and in a direction substantially perpendicular to the substrate-transportation direction.

18. (new) The substrate transportation apparatus according to claim 15, wherein said holder moving unit is operable to change a speed or an acceleration thereof depending on whether or not said substrate discharge holder is in a state of holding a component-mounted substrate, with the speed or acceleration, when said substrate discharge

holder is in the state of holding a component-mounted substrate, being less than the speed or acceleration, respectively, when said substrate discharge holder is in a state of not holding a component-mounted substrate.

19. (new) The substrate transportation apparatus according to claim 18, wherein the speed of said substrate discharge holder when said substrate discharge holder is in the state of holding a component-mounted substrate is a speed which allows to be prevented displacement, from mounted positions, of components mounted on the component-mounted substrate.

20. (new) The substrate transportation apparatus according to claim 15, wherein the first substrate position and the fourth substrate position share an identical height position, and the second substrate position and the third substrate position share an identical height position.

21. (new) The substrate transportation apparatus according to claim 20, wherein said holder moving unit comprises

(i) a feed elevation unit for vertically moving said substrate feed holder, and
(ii) a discharge elevation unit for vertically moving said substrate discharge holder,

with said feed elevation unit and said discharge elevation unit being for vertically moving said substrate feed holder and said substrate discharge holder, respectively, such that said substrate feed holder and said substrate discharge holder are separately positionable at each of

(i) a first height position corresponding to the height position of the first substrate position and the fourth substrate position,
(ii) a first retreat height position which is higher than the first height position,
(iii) a second height position corresponding to the height position of the second substrate position and the third substrate position, and

(iv) a second retreat height position which is higher than the second height position.

22. (new) The substrate transportation apparatus according to claim 21, wherein said feed elevation unit includes first and second cylinder sections, with strokes of said first and second cylinder sections being different from each other, and with the strokes of said first and second cylinder sections being combined so as to achieve vertical movement to the first and second height positions and to the first and second retreat height positions, and
said discharge elevation unit includes third and fourth cylinder sections, with strokes of said third and fourth cylinder sections being different from each other, and with the strokes of said third and fourth cylinder sections being combined so as to achieve vertical movement to the first and second height positions and to the first and second retreat height positions.

23. (new) A component mounting apparatus, comprising:

a substrate transportation apparatus; and
a mounting unit,

wherein said substrate transportation apparatus is for transporting substrates by feeding the substrates to said mounting unit, which is to mount components onto the substrates and offer the substrates as component-mounted substrates, and by discharging the component-mounted substrates from said mounting unit, with said substrate transportation apparatus including

(i) a loader unit for loading a substrate along a substrate-transportation direction such that the substrate becomes positioned at a first substrate position, from among the first substrate position, a second substrate position, a third substrate position and a fourth substrate position, with the first, second, third and fourth substrate positions being arranged sequentially next to one another,

(ii) an unloader unit for unloading from the fourth substrate position a substrate positioned thereat,

(iii) a substrate feed holder for releasably holding the substrate positioned at the first substrate position and then transferring this substrate to the second substrate position,

(iv) a substrate discharge holder for releasably holding a substrate positioned at the third substrate position and then transferring this substrate to the fourth substrate position,

(v) a holder moving unit for moving said substrate feed holder and said substrate discharge holder separately in a vertical direction and in an integrated state along the substrate-transportation direction, and

(vi) a substrate holding-and-moving device for releasably holding a substrate, said substrate holding-and-moving device capable of moving, while holding the substrate, to a substrate mounting region of said mounting unit, for mounting of a component onto the substrate, and also to the third substrate position, and said substrate holding-and-moving device also capable of moving to the second substrate.

24. (new) The component mounting apparatus according to claim 23, wherein said mounting unit comprises a mounting head unit constructed and arranged to hold respective components and mount these held components onto the substrate when the substrate is held by said substrate holding-and-moving device in the mounting region.

25. (new) A method of transporting substrates as part of a component mounting operation which is for positioning the substrates, when placed and held on a substrate holding base, at a substrate mounting region and mounting components onto the substrates so as to offer the substrates as component-mounted substrates, said method comprising:

using a substrate feed holder to hold a substrate at a first substrate position, with said substrate having been transported to said first substrate position along a transportation direction, and with said first substrate position, a second substrate position, a third substrate position, and a fourth substrate position being arranged sequentially next to each other;

positioning said substrate, while held by said substrate feed holder, at a height position above said second substrate position, and positioning a substrate discharge holder at a height

position above said third substrate position, by moving said substrate feed holder and said substrate discharge holder separately in a vertical direction and moving said substrate feed holder and said substrate discharge holder in an integrated state along said substrate-transportation direction;

moving said substrate holding base, which is holding a component-mounted substrate in said substrate mounting region, to said third substrate position;

discharging said component-mounted substrate from said substrate holding base by moving said substrate discharge holder downward, using said substrate discharge holder to hold said component-mounted substrate, and then moving said substrate discharge holder, along with said component-mounted substrate, upward to a higher height position; then

moving said substrate holding base to said second substrate position;

feeding said substrate to said substrate holding base by moving said substrate feed holder downward and releasing said substrate from said substrate feed holder; and

moving said substrate holding base to which said substrate has been fed to said substrate mounting region, while moving said component-mounted substrate held by said substrate discharge holder to said fourth substrate position in an integrated state with said substrate feed holder along said substrate-transportation direction.

26. (new) The method according to claim 25, wherein

moving said component-mounted substrate held by said substrate discharge holder to said fourth substrate position comprises moving said component-mounted substrate after beginning performance of a mounting operation, in said substrate mounting region, for mounting components onto said substrate fed to said substrate holding base.

27. (new) The method according to claim 25, wherein

moving said component-mounted substrate held by said substrate discharge holder to said fourth substrate position comprises moving said substrate discharge holder such that a speed or an acceleration of said substrate discharge holder is less than a speed or an acceleration,

respectively, of said substrate discharge holder when said substrate discharge holder is not holding said component-mounted substrate.

28. (new) The method according to claim 25, further comprising:

performing timing control such positioning said substrate, while held by said substrate feed holder, at said height position above said second substrate position, positioning said substrate discharge holder at said height position above said third substrate position, and moving said substrate holding base to said third substrate position, results in said substrate feed holder and said substrate discharge holder being positioned, almost as soon as said substrate holding base is moved to and positioned at said third substrate position, at a height position so as to avoid said substrate holding base at said third substrate position

29. (new) The method according to claim 25, further comprising:

performing timing control such that using said substrate feed holder to hold said substrate transported to said first substrate position comprises using said substrate feed holder to hold said substrate based on

(i) an amount of time necessary for mounting the components onto said substrate positioned in said substrate mounting region and offering this substrate as a component-mounted substrate, and

(ii) an amount of time necessary for holding by said substrate feed holder said substrate transported to said first substrate position, and positioning this held substrate at the height position above said second substrate position.